ScaRaB:

ScaRaB Mission status and instrument performances

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Ouahid Aznay : C-S

- ScaRaB :
  - optical scanning radiometer devoted to the measurements of radiative fluxes at the top of the atmosphere (TOA)
  - Initially, ScaRaB was realized in order to complete the ERBE-CERES US missions
    - Shares many common points with CERES

- Two models have already been sent :
  - Aboard a METEOR-3M Russian satellite launched in January 1994 onto a quasi-polar orbit at an altitude of 1200 km
  - Aboard a Russian RESURS platform launched on July 10th, 1998 at an altitude of 830 km.
- A new instrument was built by CNES for the Indo-French satellite MEGHA-TROPIQUES, launched on October 12th, 2011 from Sriharikota in India

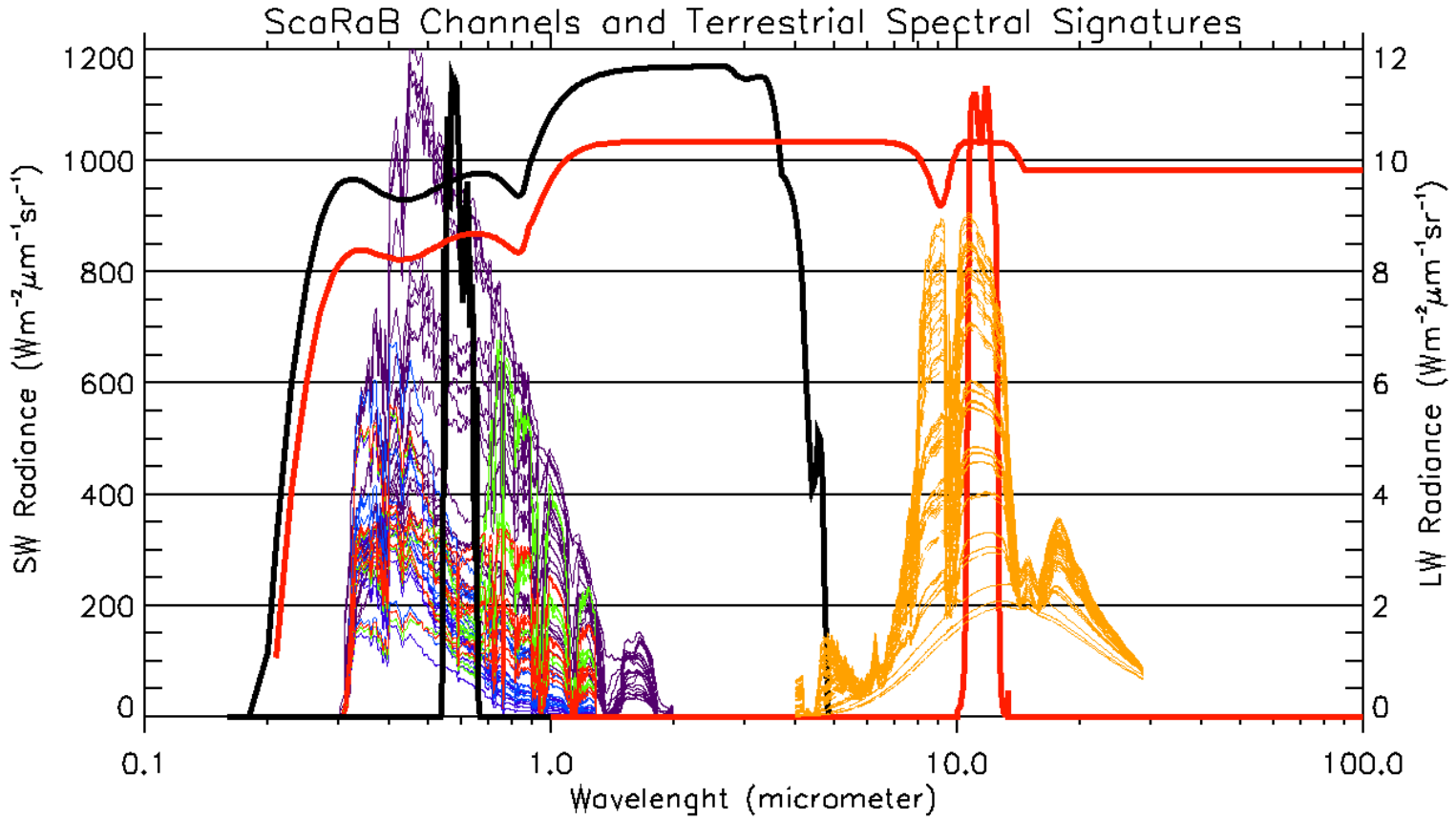
- MEGHA-TROPIQUES is a satellite designed to study convective systems, focusing on the analysis of water cycle with water vapour distribution and transport, convective systems life cycle and energy exchanges in the tropical belt

- MEGHA-TROPIQUES carries three scientific passive instruments:
  - **MADRAS** : A multi–channels self calibrating microwave imager mainly aimed at studying precipitation and cloud properties.
  - **SAPHIR** : A microwave instrument used to retrieve water vapour vertical profiles.
  - **ScaRaB**

- MEGHA-TROPIQUES is developed through a collaboration between ISRO (Indian Space Research Organisation) and CNES (Centre National d'Etudes Spatiales) which provided the ScaRaB instrument.
- Main characteristics of the low inclination and non-synchronous orbit :
  - Inclination: 20°
  - Phasing : 7 days phased orbit
  - Reference equatorial nominal altitude: 866 Km

Canal	Description	Spectral range	Filter type
1	Visible (VIS)	**0,55 — 0,65 µm**	Interferential
2	Solar (SW)	**0,2 — 4 µm**	Silica filter
3	Total (T)	**0,2 — 200 µm**	No filter
4	IR Window (IRW)	**10,5 — 12,5 µm**	Interferential

- Channels and observed spectra



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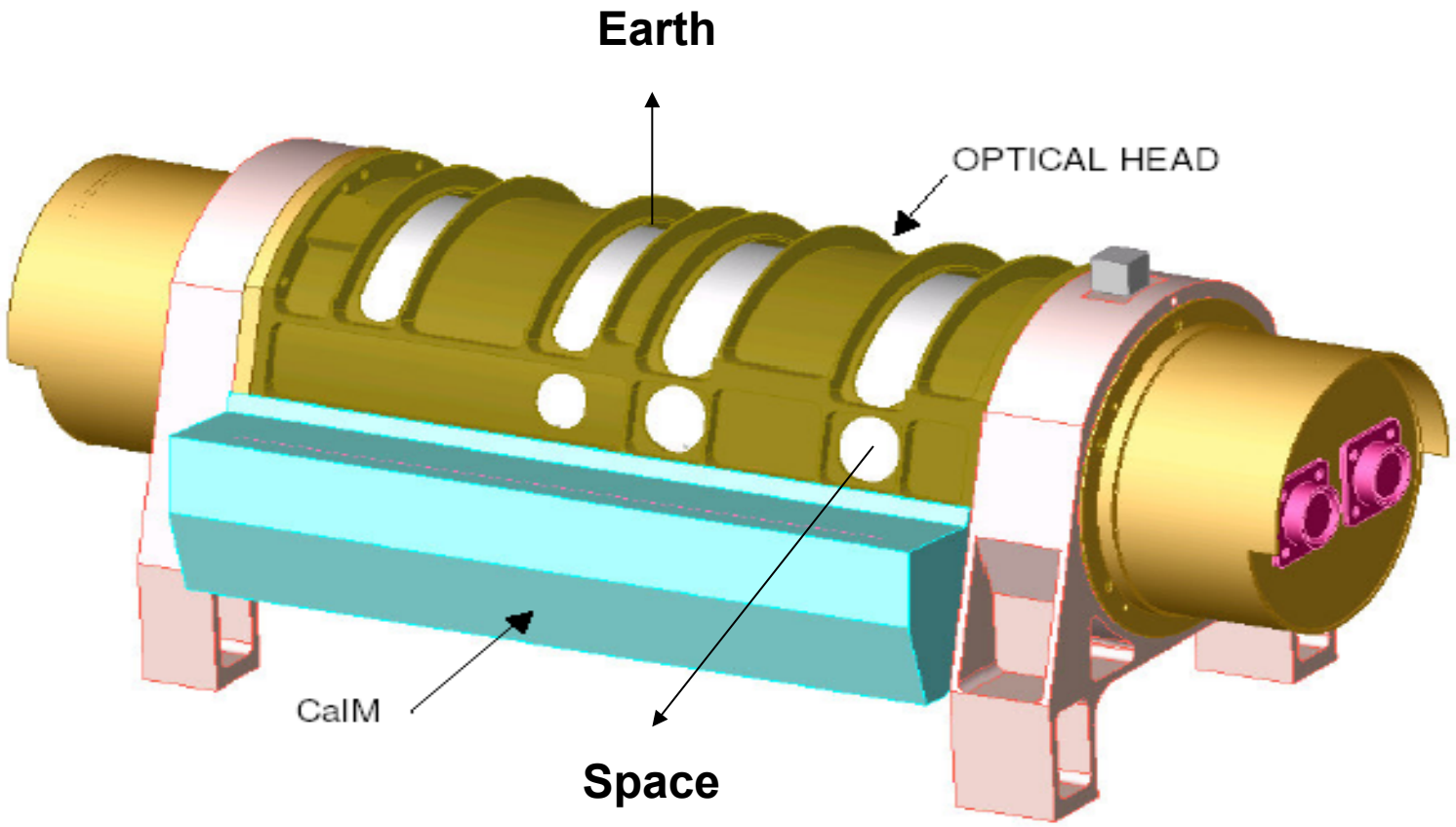

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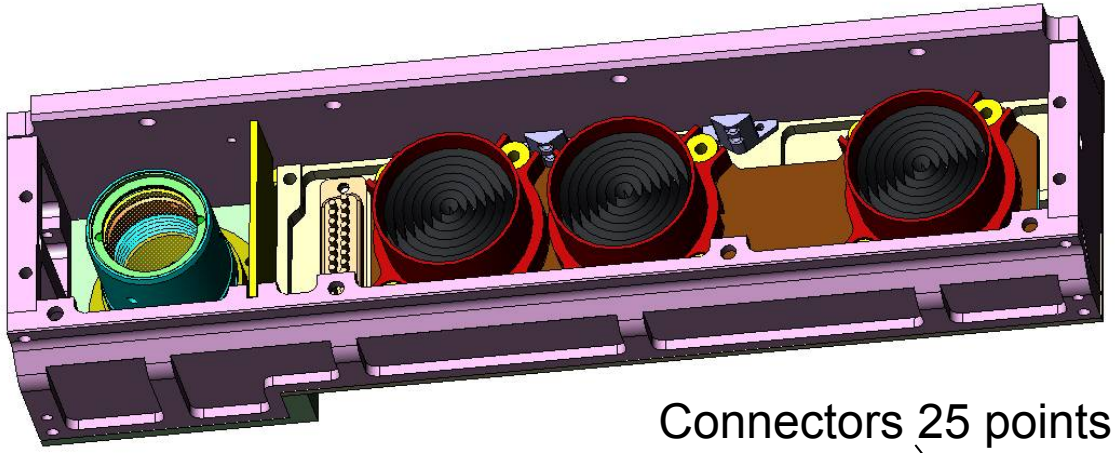
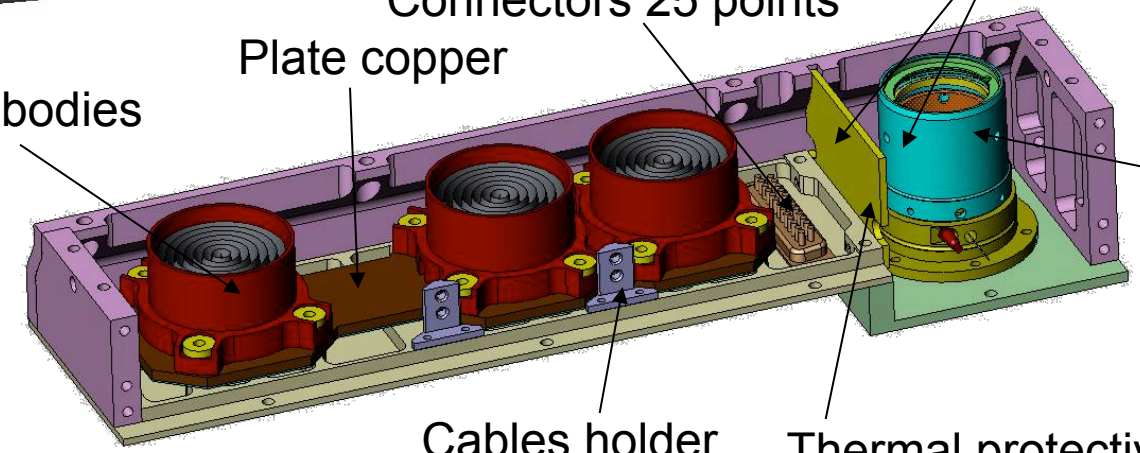
Two internal sides of CalM





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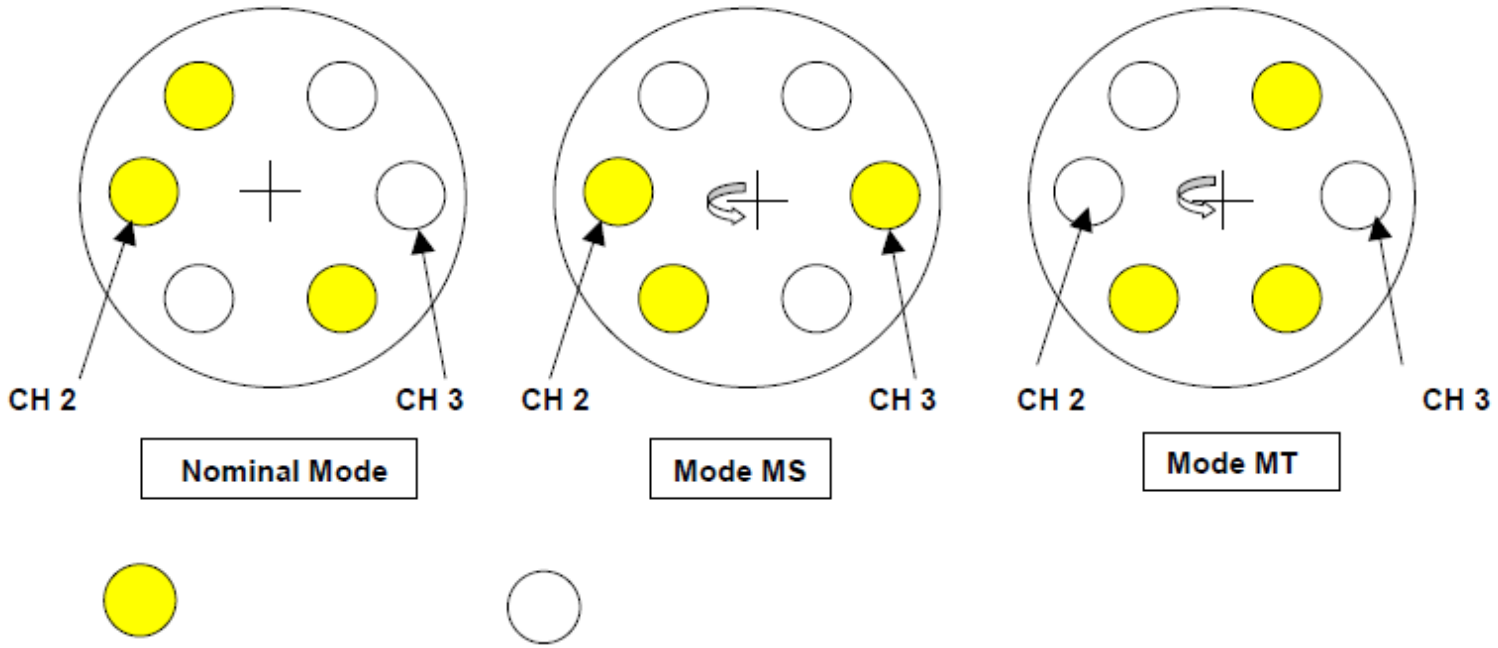
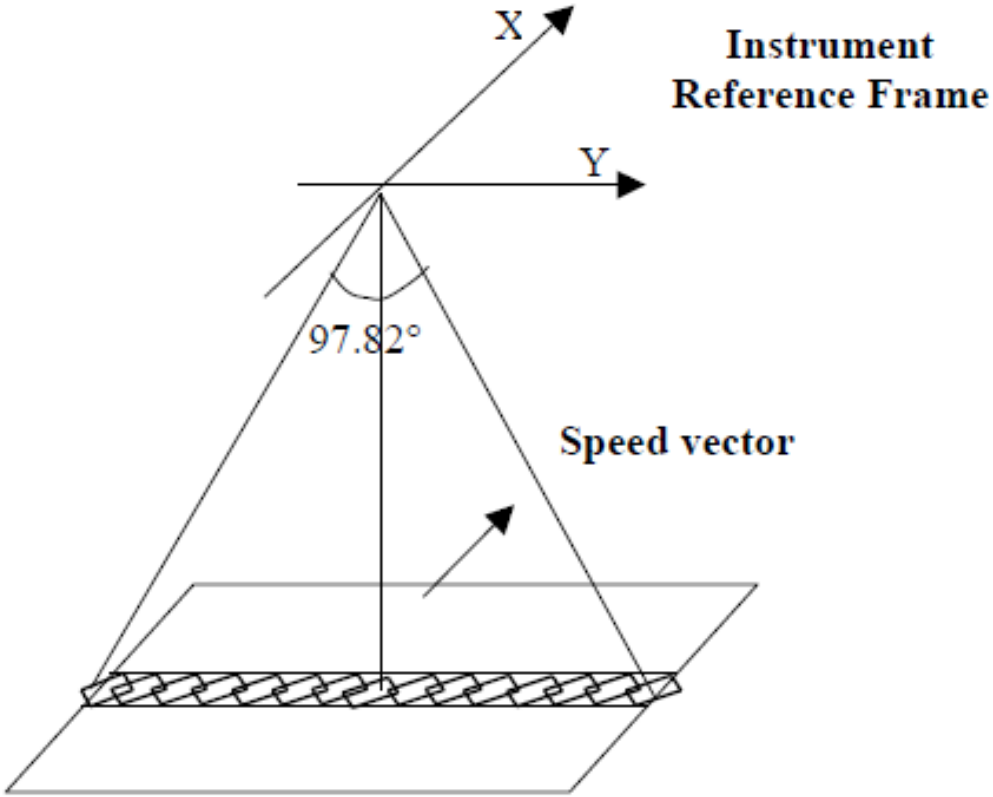
- Use of a filter wheel to set A’





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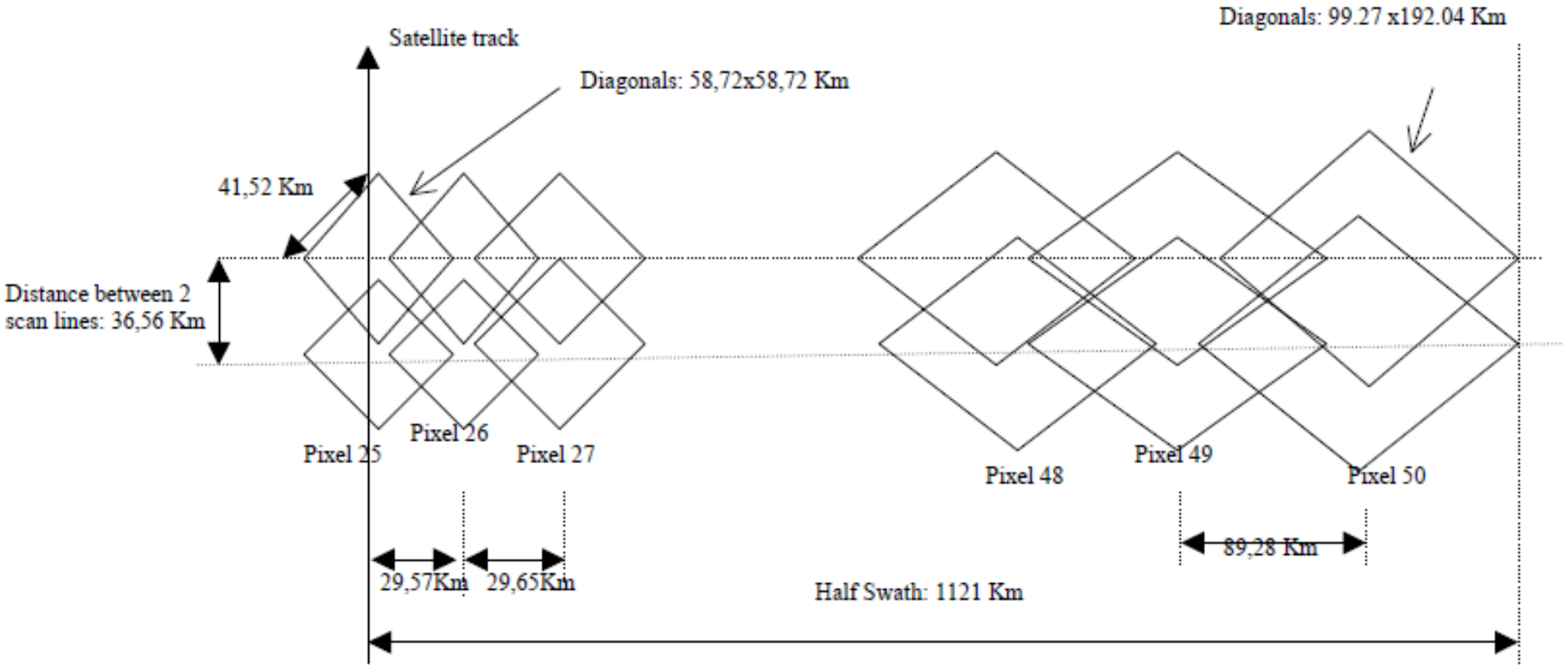

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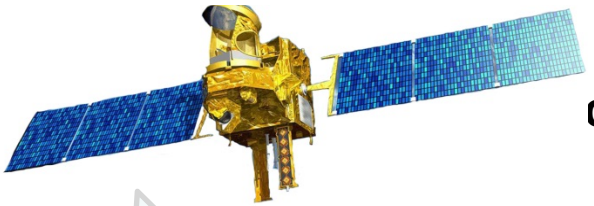
MISSION STATUS

- This mission delivers a lot of data for science but not only : it is useful for people in the world as well
- SAPHIR NRT retrieved by EUMETSAT on April 2014
- MADRAS data opened on October 2015
- 1st exploitation review and mission extension on May 23th 2014
- Exploitation review December 4th 2015
- New review to extend the mission on May 23th 2016 =>



caRaB on megha tropiques

Algo L2 – L4

Users -> Products

- **L1A ; L1A2 dump & orbit MADRAS; SAPHIR; SCARAB.**
- **L2 rain MADRAS;**
- **L2-RH&UTH SAPHIR;**
- **L2 FLUX SCARAB;**
- **L4 TAPEER BRAIN (on going).**

French Science Team

Science ground segment and Data Disseminatio n

Internet backup

CNES station network

ISTRAC – ISRO station network

TEC Center of Expertise

SAC

ISSDC

MOSDAC

L0 – L1 – HKTM…..

Raw TM

L0 – L1 – HKTM…..

Raw TM

L1 (all)

EUMETCAST

Users :
•Operational Assimilation
–Météo-France
–JMA
–NCMRWF
–SAC Ahmedabad
•Operational
– NASA
- UK MET Office
•Testing on going
–NOAA
–ECMWF

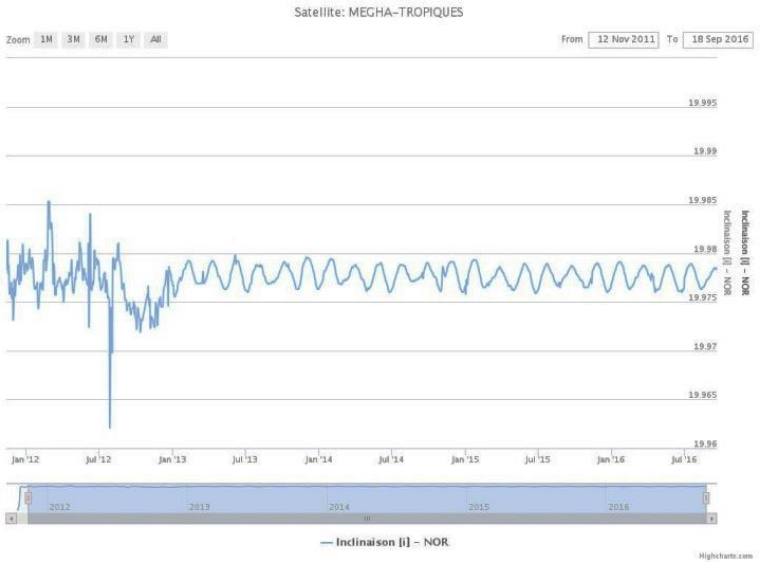
Users
T.Trémas Centre National d'Etudes Spatiales

Network : Orange + Indian provider

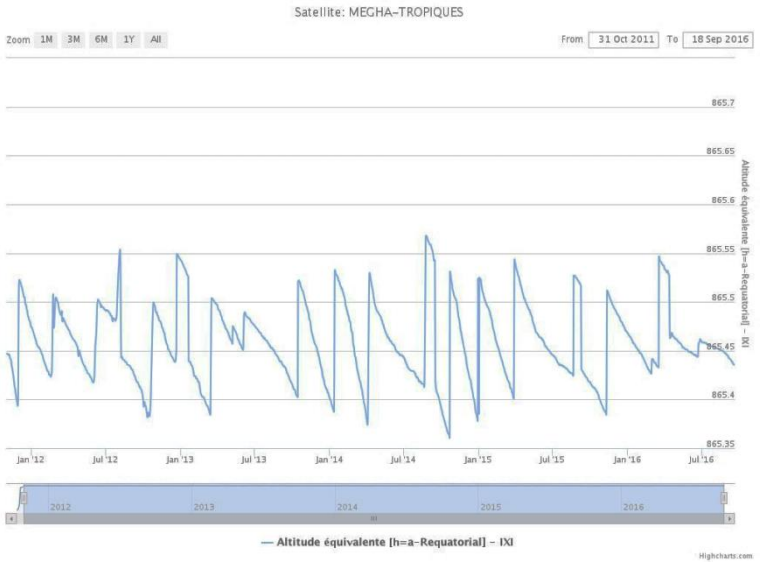
NRT SAPHIR L1 dump

- **Satellite : nothing to report**
  - **We have still about 150kg of ergol, about 0,5kg by year is needed**
    - **So we have fuel for the next 300 years ☺**
  - **No anomaly until now**
  - **All orbital parameters are constant and ok since the launch ☺**

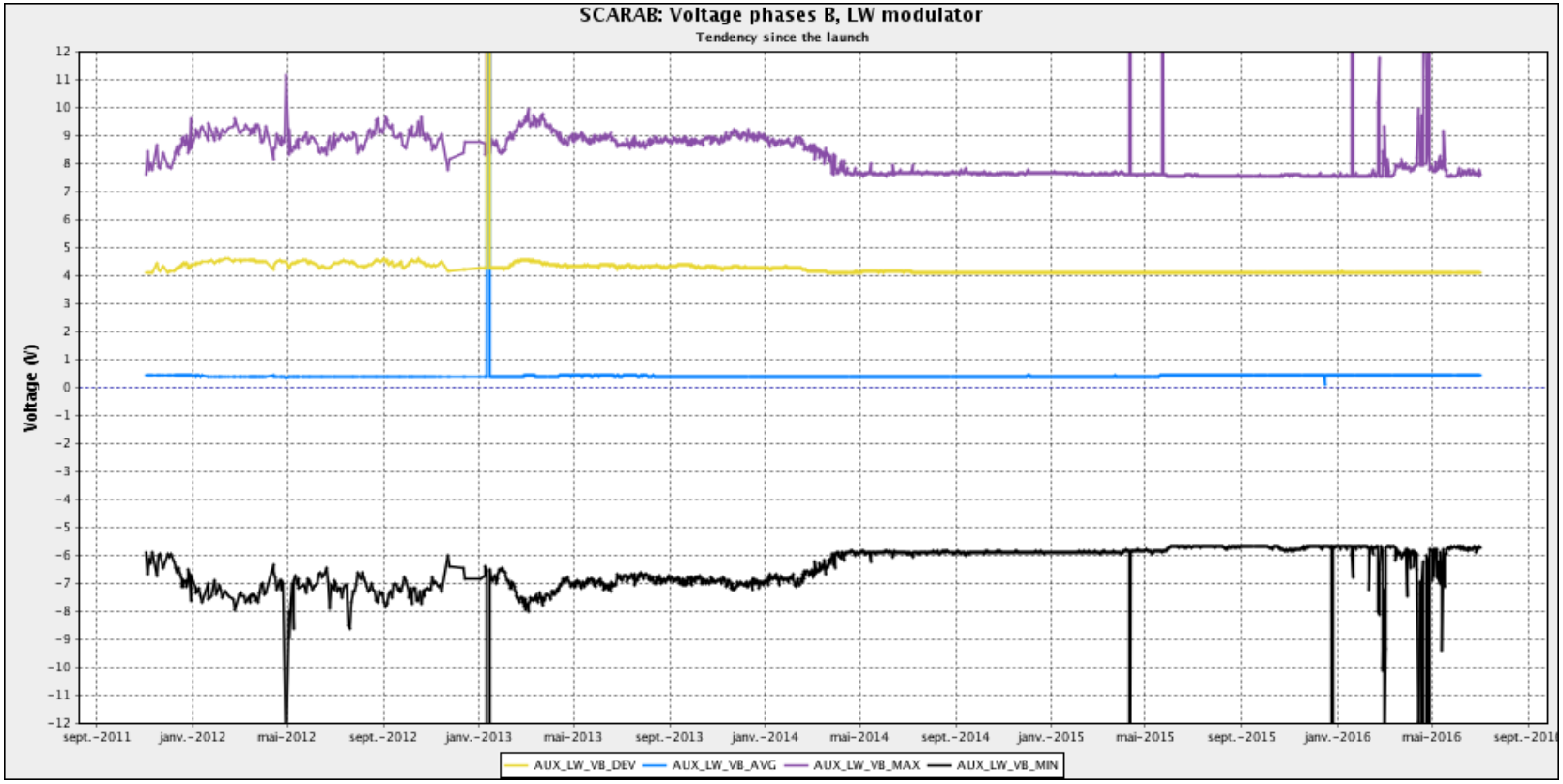
Satellite Tilt



Satellite altitude



- Some warnings on the modulator mechanism :
- Surely due to lubricant cluster. Now all is ok!



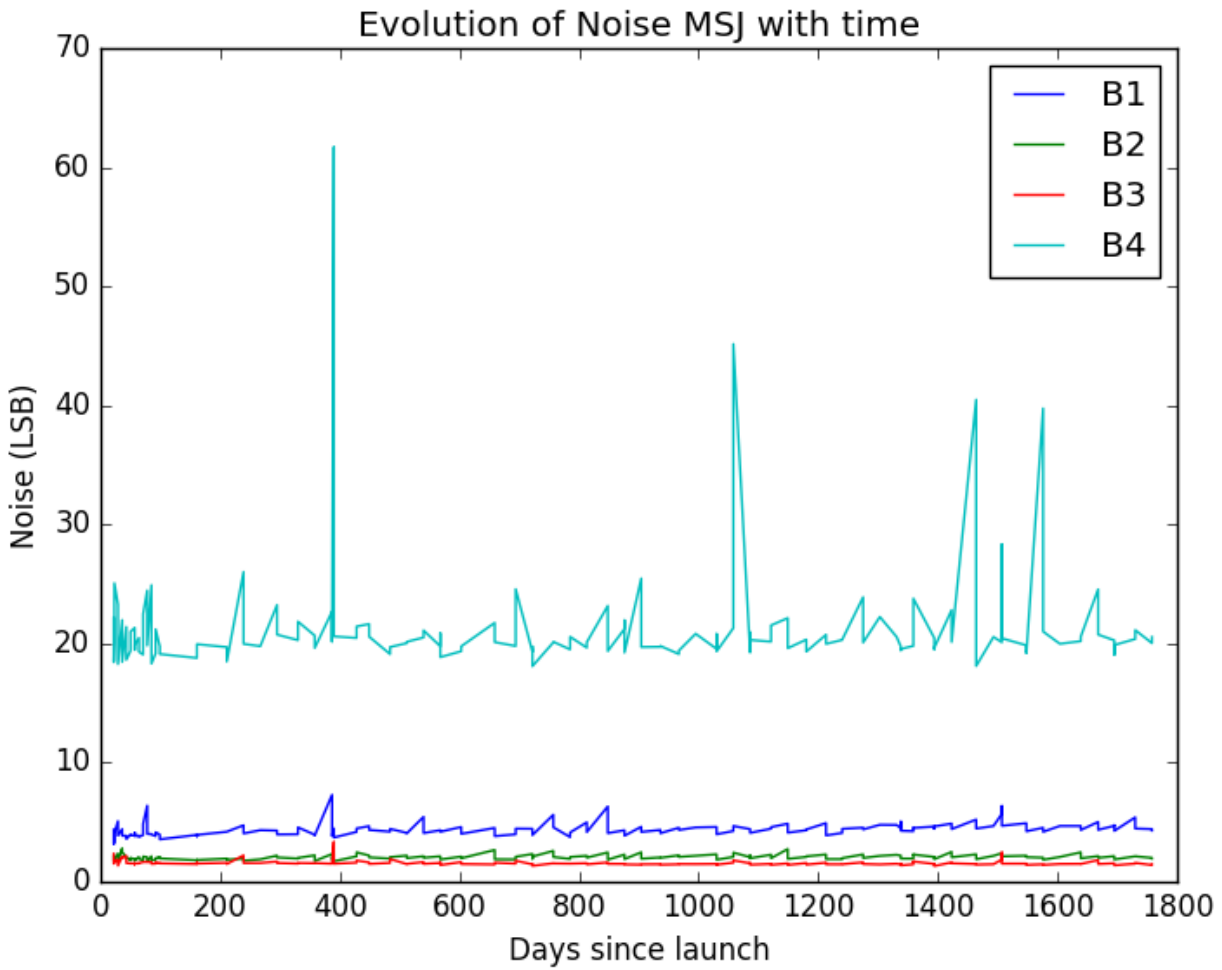
- Station network:

- Some jamming has been observed at Bangalore station beginning 2016, but today the situation is ok.

- Data link:
  - Some difficulties to improve the reliability of the network
  - The last weeks :
    - Backup using internet to deliver data from the stations
  - => we didn't lost data (operational)

- Anomalies on products L1 :

Mainly due to the jamming , some geolocation are not flagged correctly in the data



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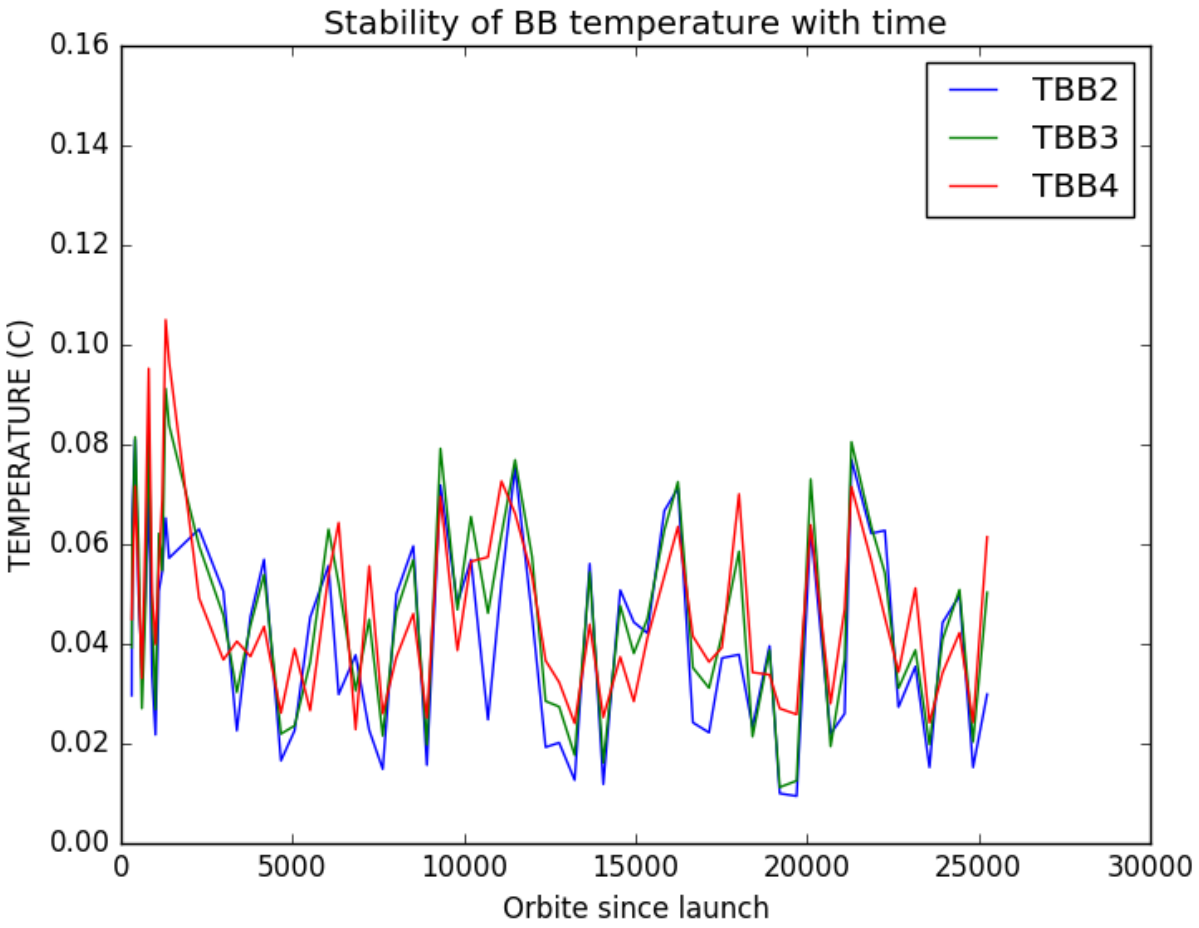

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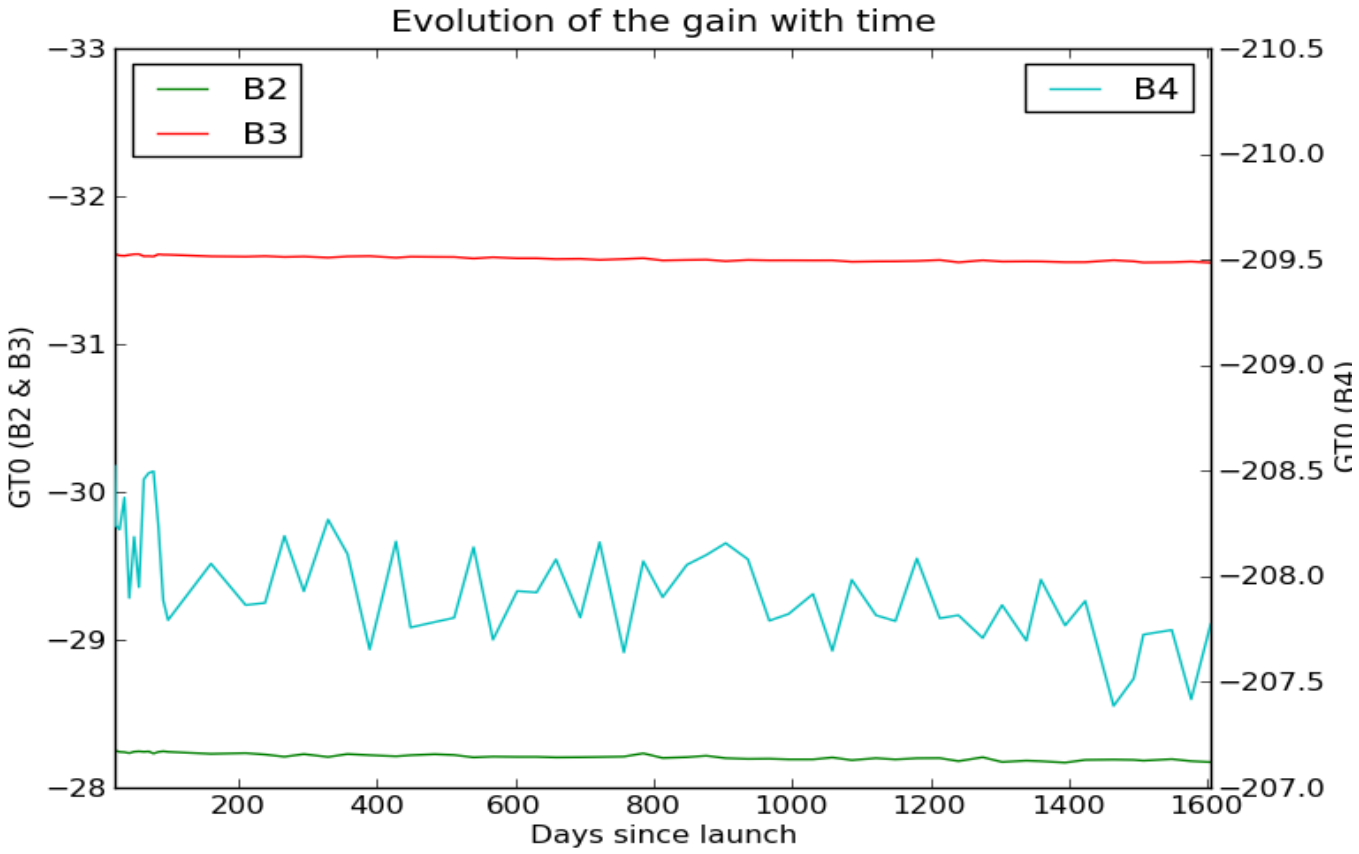
Scarab instrument stability – relative gains



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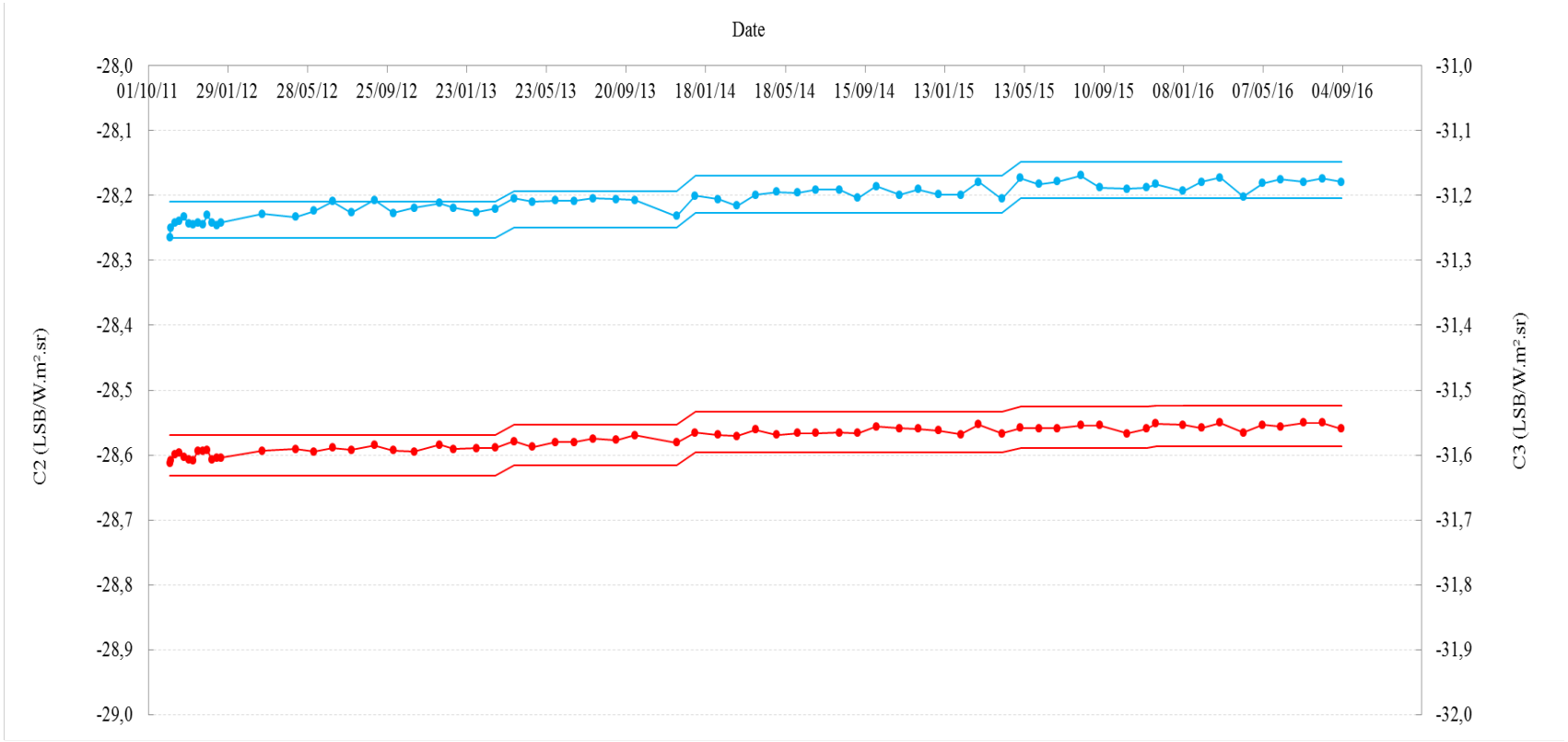
Gain B2 (solar channel) & B3 (total channel)



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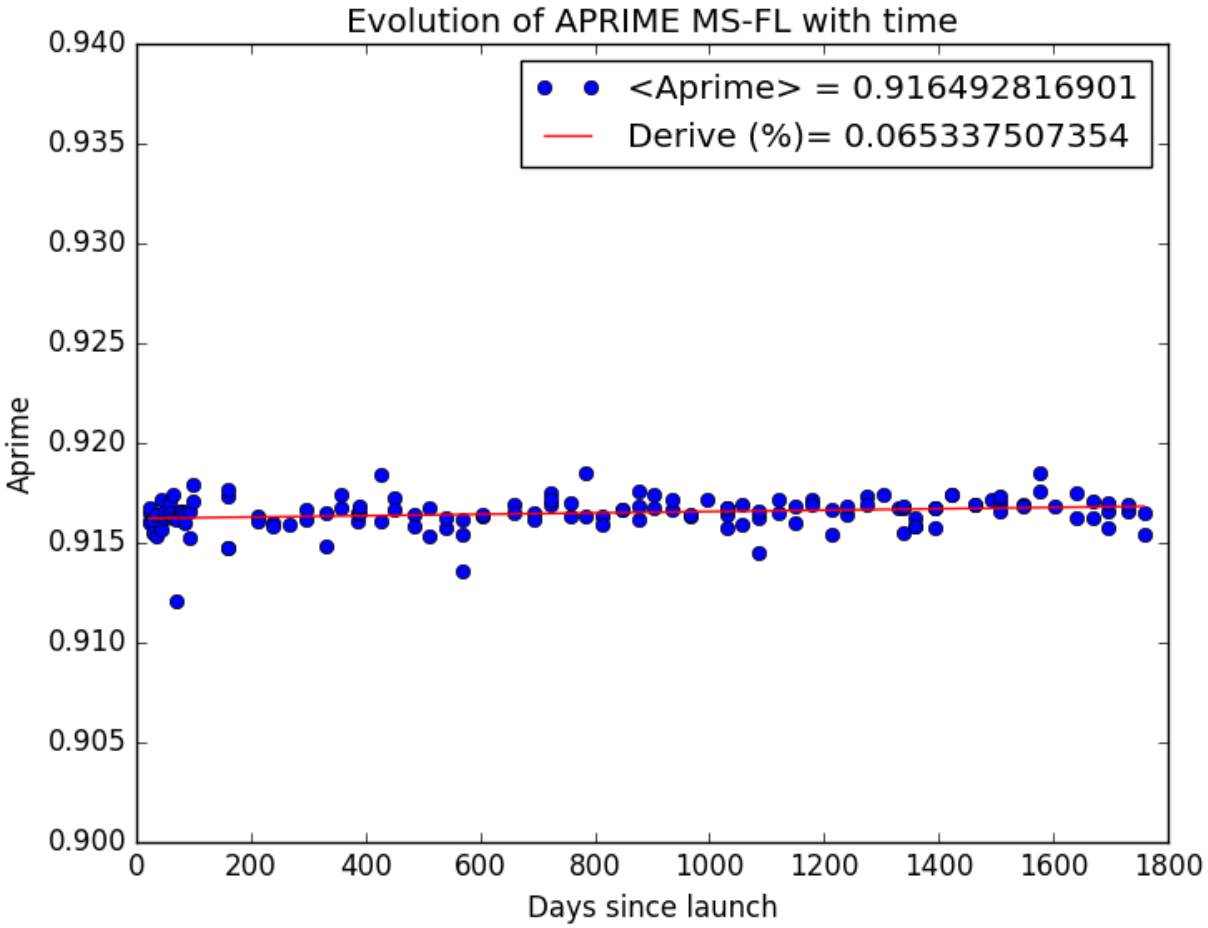
Scarab instrument stability – A'



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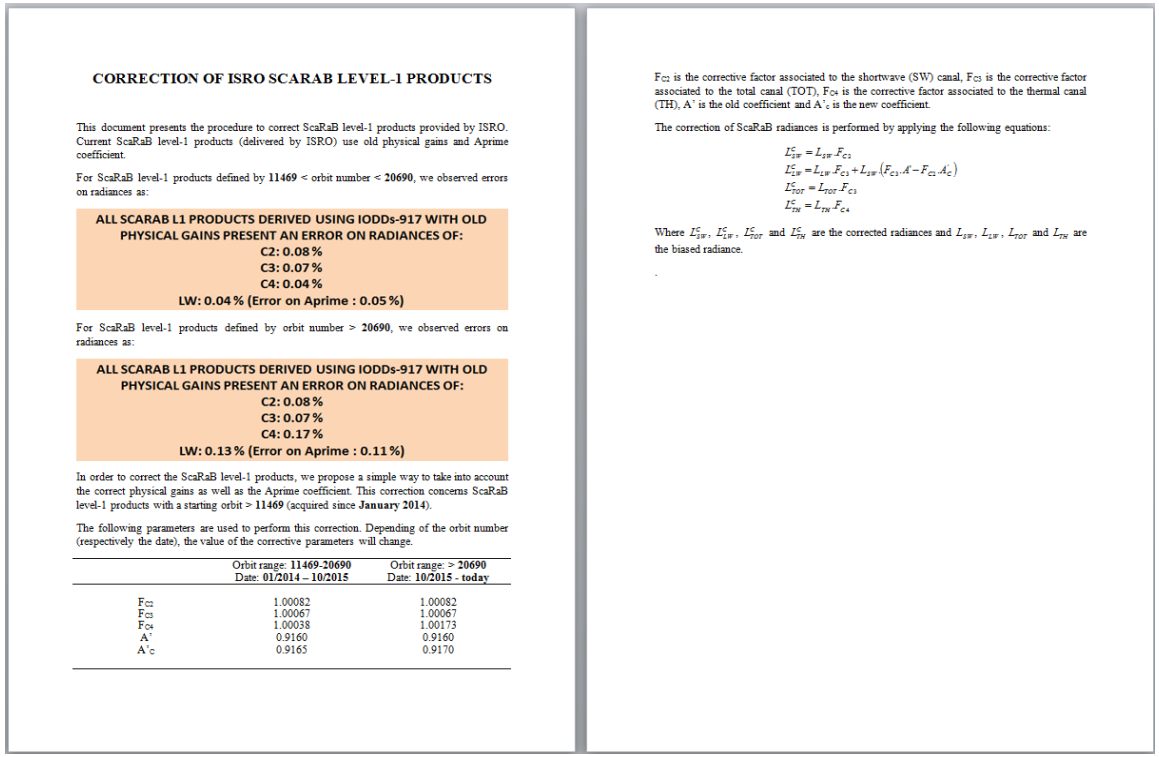
- **Very slight drifts : no consequences :**

- **A' drift : 0,07% for a requirement of 0,1% (over a life time of 3 years, initial goal)**
- **Gain ratio (G2/G3) of 0,96% for a requirement of 1%**

- **According to the survey, parameters are updated. They are then gathered in IODD files, used as configuration parameters for ISRO Ground Segment (ISSDC)**

- Last IODD have not been activated at ISSDC, but L1 files have been produced
  - ⇨ Need to apply a slight correction to L1 files
  - ⇨ Correction will be proposed at ICARE when loading L1 files



CORRECTION OF ISRO SCARAB LEVEL-1 PRODUCTS

This document presents the procedure to correct ScaRaB level-1 products provided by ISRO. Current ScaRaB level-1 products (delivered by ISRO) use old physical gains and Aprime coefficient.

For ScaRaB level-1 products defined by **11469** < orbit number < **20690**, we observed errors on radiances as:

ALL SCARAB L1 PRODUCTS DERIVED USING IODDs-917 WITH OLD PHYSICAL GAINS PRESENT AN ERROR ON RADIANCES OF:
C2: 0.08 %
C3: 0.07 %
C4: 0.04 %
LW: 0.04 % (Error on Aprime : 0.05 %)

For ScaRaB level-1 products defined by orbit number > **20690**, we observed errors on radiances as:

ALL SCARAB L1 PRODUCTS DERIVED USING IODDs-917 WITH OLD PHYSICAL GAINS PRESENT AN ERROR ON RADIANCES OF:
C2: 0.08 %
C3: 0.07 %
C4: 0.17 %
LW: 0.13 % (Error on Aprime : 0.11 %)

In order to correct the ScaRaB level-1 products, we propose a simple way to take into account the correct physical gains as well as the Aprime coefficient. This correction concerns ScaRaB level-1 products with a starting orbit > **11469** (acquired since **January 2014**).

The following parameters are used to perform this correction. Depending of the orbit number (respectively the date), the value of the corrective parameters will change.

	Orbit range: **11469-20690** Date: **01/2014 – 10/2015**	Orbit range: > **20690** Date: **10/2015 - today**
F_{C2}	1.00082	1.00082
F_{C3}	1.00067	1.00067
F_{C4}	1.00038	1.00173
A'	0.9160	0.9160
A'c	0.9165	0.9170

F_{C2} is the corrective factor associated to the shortwave (SW) canal, F_{C3} is the corrective factor associated to the total canal (TOT), F_{C4} is the corrective factor associated to the thermal canal (TH), A' is the old coefficient and A'$_c$ is the new coefficient.

The correction of ScaRaB radiances is performed by applying the following equations:

$$L^C_{SW} = L_{SW} \cdot F_{C2}$$
$$L^C_{LW} = L_{LW} \cdot F_{C3} + L_{SW} \cdot (F_{C2} \cdot A' - F_{C2} \cdot A_C)$$
$$L^C_{TOT} = L_{TOT} \cdot F_{C3}$$
$$L^C_{TH} = L_{TH} \cdot F_{C4}$$

Where L^C_{SW}, L^C_{LW}, L^C_{TOT} and L^C_{TH} are the corrected radiances and L_{SW}, L_{LW}, L_{TOT} and L_{TH} are the biased radiance.